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Long-Run Determinants of Japanese Import Flows from USA and China: A Sectoral Approach

Abstract*:*

We analyze the determinants of the sectoral Japanese imports from her two main partners, China and the USA over the period 1971-2007. We estimate cointegration relationships with breaks, using the Saikkonen-Lütkepohl method. For six sectors: foods, raw materials, textile, mineral fuel, chemicals and machinery and equipment, we show that if the domestic demand affects positively the imports, the impact of prices changes can be different whether we retain the relative prices (homogeneity hypothesis) or we consider both domestic and import prices. As expected, the relative prices changes have a negative effect on imports, while when we decompose the relative prices between imports prices and domestic (corporate) prices, except in one case (textile imports from the USA), we can reject the homogeneity hypothesis. A possible explanation is the greater volatility of import prices compared to domestic prices which leads importers to wait when import prices change, insofar as they don't know if these changes are temporary or permanent.

1. Introduction

Imports are in most cases favourable to growth since they contribute the dissemination of the innovations which will be source of productivity gains: “There is evidence that imports are a significant channel of technology diffusion” (Keller, 2004 p. 752). So, greater imports of products competing with domestic products often spur innovation, as has been shown by Lawrence and Weinstein (1999) in the case of Japan, under consideration in this paper.

China, the European Unions and the United States are nowadays the main trading partners of Japan, as table 1 shows. On the import size, China ranks first, and the USA second, which leads us to choose these two countries as trading partners of Japan in order to investigate the long-run determinants of Japanese import flows. Which are the determinants of Japanese imports? Generally speaking, the domestic demand constitutes an important determinant. But, on the other hand, changes in relative prices and consequences in international trade are still a matter of concern and polemic. Debates on the under-evaluation of the yuan or on the overvaluation of the euro facing the American dollar are particularly brisk. Most often the academic literature deals with this subject by analysing the impact of the exchange rate on the exports of a country. Indeed, exports often constitute a powerful motor of economic growth. Following the example of Germany, Japan is a textbook case of this type of strategy.

Table 1: *Top 5 Japanese Export & Import Partners in 2005*
(US$ billion and % of total)

Japanese Exports	Japanese Imports
1. United States ... US$135.9 billion (22.9% of total Japanese exports)	1. China ... US$108.5 billion (21.1% of total Japanese imports)
2. European Union ... $87.6 billion (14.7%)	2. United States ... $65.3 billion (12.7%)
3. China ... $80.1 billion (13.5%)	3. European Union ... $58.6 billion (11.4%)
4. South Korea ... $46.6 billion (7.8%)	4. Saudi Arabia ... $28.7 billion (5.6%)
5. Chinese Taipei ... $43.6 billion (7.3%)	5. United Arab Emirates ... $25.3 billion (4.9%)

Source : WTO Statistics

We have shown however that all sectors do not have the same sensibility to the exchange rate variability (Jaussaud and Rey, 2007). However, the effects of the relative prices are not supposed to be limited to the one hand of trade, that is to say exports. The condition of Marshall-Lerner-Robinson emphasizes precisely that it is at the same time exports and imports which are sensitive to the fluctuations of the relative prices expressed in common currency, i.e. at the real exchange rates.

The empirical literature has focused on the influence of the exchange rate variability, i.e. the volatility and the misalignements (gap between the exchange rate and its equilibrium value), on the exports mainly (see among others, Choudhry, 2004; Clark and al., 2004; Rey 2006). We propose here to study more in detail the impact of the relative prices on the Japanese imports. But an analysis of the total imports would not be appropriate, as the price-elasticity of import demand differs according to sectors/products. For instance, in a period of increase in prices of raw materials, a depreciation of the exchange rate can have inflationary effects which finally can, via the increase of expenses of imported raw materials, penalize growth in return, while for other sectors the same depreciation will reduce imports volumes. For these reasons, we choose to study the influence of the determinants on the Japanese imports from China and the United States for six categories of products/sectors: food products, raw material, mineral fuel, textile, chemicals and machinery and equipment. On the basis of a precise analysis of Japanese imports by sectors, we will undertake an econometric analysis on determinants of imports.

For that,

1- We estimate functions of Japanese imports from China and the United States for each of six sectors.
2- The econometric estimate of imports functions will rest on standard approaches in terms of cointegration (long run relationships) and Vector Error Correction Model (VECM, short run relationships). The covered period will go from 1971 to 2007.

To analyze the long run determinants of Japanese imports by sectors, we proceed as follows. Section 2 presents a brief overview of the evolution of sectoral imports from China and the United States. In section 3, the import model is exposed. Section 4 presents preliminary data analysis, i.e. units root and cointegration tests. Specifically, we employ the Saikkonen-Lütkepohl method, which takes into account the presence of breaks in the variables. Section 5 reports and analyses the empirical results from the Vector Error Correction Model (hereafter VECM) estimation. Section 6 concludes this contribution.

2. Background

In order to be able to better interpret some of the results that we may find, it may be useful to remind the context: Japan’s foreign trade and foreign trade policy (2.1). Then we shall consider more precisely trends in Japanese imports, on a sectoral basis (2.2).

2.1. Japan’s foreign trade, a long term perspective

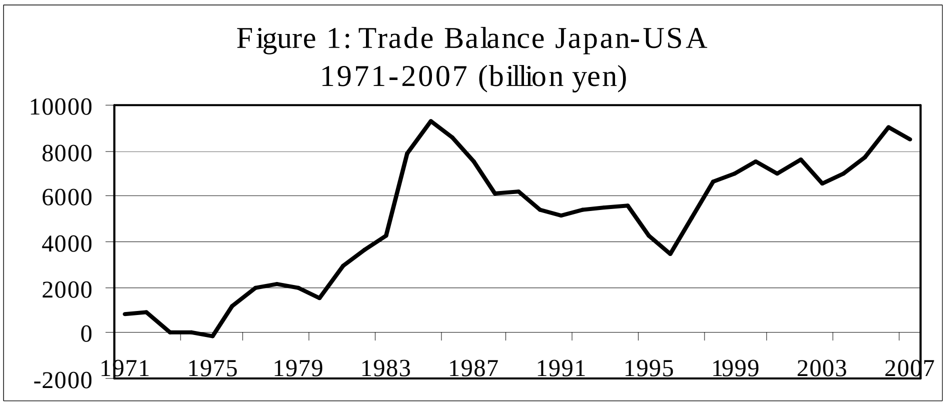
Through the period under investigation (1971-2007), Japan’s foreign trade has experienced various situations, or sub-periods, that may be summarized as follows:

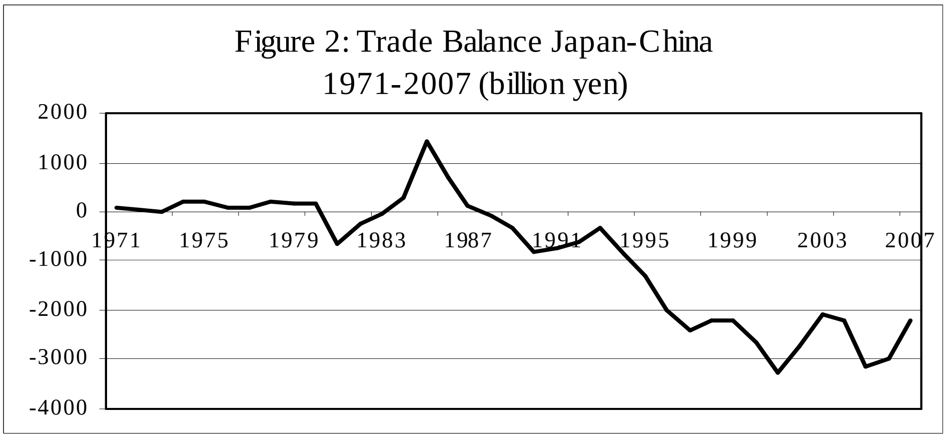
- during the 70s, Japan’s has still a rather fragile equilibrium in foreign trade towards the rest of the world. Exports are growing quickly on the period, but imports are dramatically affected by the two oil shocks (1973 et 1979);
- during the first half of the 80s, Japan enjoys increasing trade surpluses, as Japanese firms emerge as major exporters and majors competitors to the West in an increasing

number of industries. Trade frictions intensify, the yen is regarded by most observers as significantly undervalued, and the US dollar as too strong. This leads to the Plaza Agreement in September 1985, and subsequent currencies realignment (almost 40% appreciation within one year for the yen against the US dollar);

- from 1986 to 2007, trade surpluses of Japan have been rather stabilized, at very high levels indeed, from 80 to 100 billion dollars a year, and her foreign exchange policy is devoted to avoidance of strong fluctuations of the yen towards the US dollar;
- from 2008, a sharp decline in surpluses of Japan occurs, in relation with the current economic crisis, but this is out of the period under investigation in this paper.

From 1986 to 2007, however, behind such high levels of global trade surpluses, strong evolution in the structure of trade has occurred. Costs in Japan have increased so much during the 80s, inflated by the appreciation of the yen after the Plaza Agreement, that Japanese companies have developed delocalization and outsourcing strategies to the rest of Asia (South East-Asia first). Then, following the burst of the financial bubble, in 1989, and through the huge difficulties of the 1990s (the so-called *lost decade*), they have intensified these strategies, particularly towards China, and then to a lesser extent towards Vietnam, India, and others. Production of consumption goods in cheap labor countries, and of parts and components, by Japanese subsidiaries in these countries or by local suppliers, has led to a rapid surge of imports of Japan. This explains for instance the increasing trade deficit with China from 1989 up to now (figure 2). As regards to the USA, the stabilization of trade surpluses is partly based on shifts of export towards that country from Japan production bases to Japanese subsidiaries in China and elsewhere. However, in global terms, Japanese manufacturers keep strong competitive advantage, which reflects in high level of trade surplus towards the USA (figure 1).





Trade frictions during the 80s not only led to currencies adjustment through the Plaza Agreement. They led also to the step by step opening of the Japanese market, under pressure of the USA, and to a lesser extent, of Europe. Following intense negotiations, several programs of liberalization of imports of goods and liberalization in the field of services have been implemented in Japan from 1985 to the mid 1990s (Keidanren, 1996). These programs too have favored the gradual increase of imports of the country. However, increase in imports has occurred at very different space from sector to sector.

2.2. Trends in sectoral Japanese imports

We consider in this paper a breakdown of overall imports of Japan in six different sectors: food, textile, chemicals, raw materials, mineral fuels, and machinery and equipments.

In the case of imports from the USA, as figure 3 and 5 show, real imports for most sectors have been rather stable on the period under investigation, but for mechanical equipments which recorded a significant increase. As a consequence, the sectoral contribution of mechanical equipments to the overall imports of Japan from the USA has increased on the period, at least until 1996.

In the case of imports from China, the huge surge in real terms has occurred from the beginning of the 90s, but for mineral fuels (figure 4). Imports of textiles products, and to a lesser extent, of food products have increased first, and then the strongest increases are for mechanical equipments and chemicals. This clearly reflects the development process of the Chinese economy, with a sophistication of productions, either by foreign companies invested in China and by pure Chinese companies. As a consequence, the structure of sectoral imports of Japan from China has dramatically changed during the period under investigation (figure 6).

Contrasted sectoral contribution both from the USA and from China show that a sectoral approach of the analysis of determinants of Japanese imports is required. A global approach of imports would provide only a limited insight. Let us now consider, in section 3, the import model.

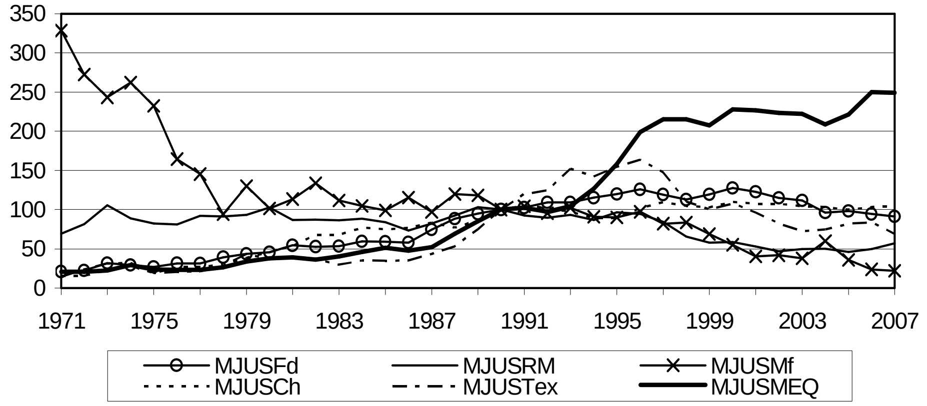


Figure 3: Real Imports by sector of Japan from USA 1971-2007 (1990:100)

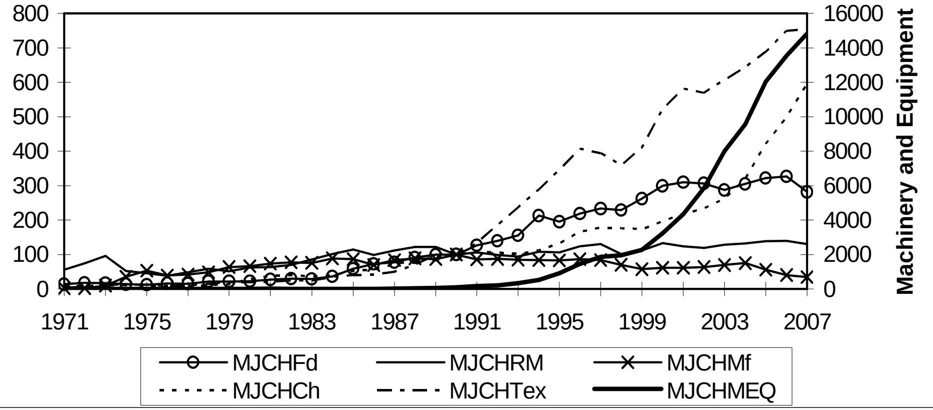


Figure 4: Real Imports by sector of Japan from China 1971-2007 (1990:100)

Notes: MJCHaa = imports of Japan from China in the aa product category; MJUSaa = imports of Japan from the United States for the same category. Fd = food, Tex = textile, Ch = chemicals, Rm = Raw materials, Mf = Mineral fuels, and Meq = machinery and equipments. See the Appendix for the data sources

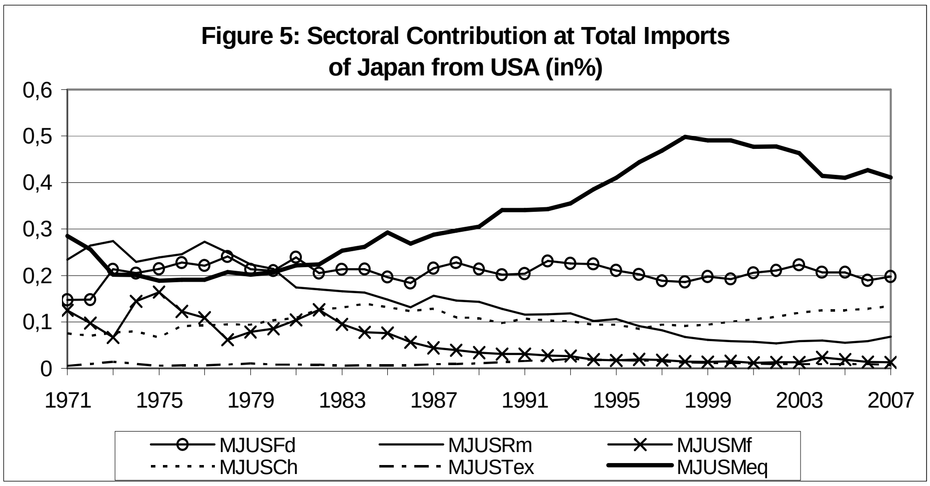


Figure 5: Sectoral Contribution at Total Imports of Japan from USA (in%)

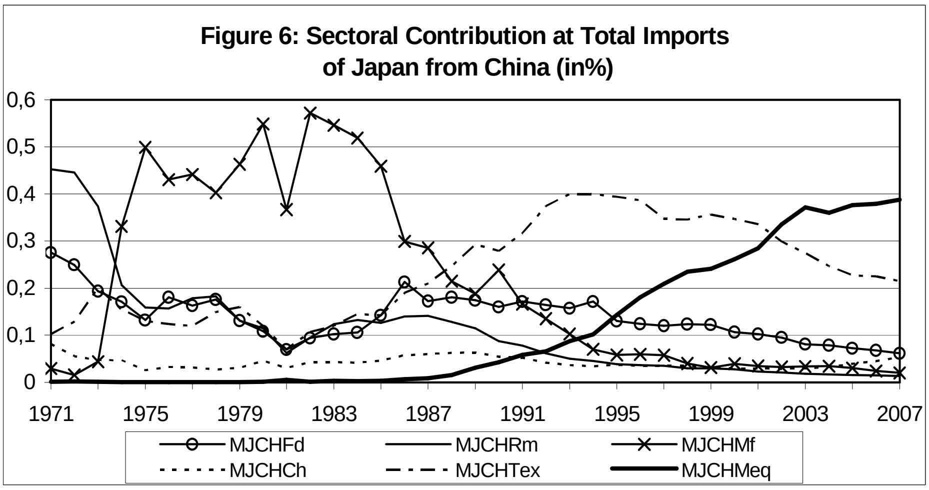


Figure 6: Sectoral Contribution at Total Imports of Japan from China (in%)

3. Import model

We retain an imperfect substitutes model for imports, i.e. a model in which imports goods are imperfect substitutes for goods produced and consumed at home. For an *i* sector, we have the long-run specification of the imports demand:

$$\frac{M_{it}}{P_{Mit}} = f\left(Y_t, \frac{P_{Mit}}{P_{dit}}\right) \tag{1}$$

where M_{it} is the value of imports for each *i* sector, Y_t real income (real Gross Domestic Product) or some other activity variable, *P* the general price index. P_{Mit} is the price (in domestic currency, i.e. yen) paid by the importers, and P_{dit} is the domestic price of *i* goods. The use of a relative price ratio P_{Mit}/P_{dit},, i.e. a real exchange rate, instead of two separate price terms means that we accept the assumption of homogeneity, which is a rather strong hypothesis when applied to both demanders and suppliers in the domestic markets. Indeed, the zero homogeneity assumption implies identical, up to the sign, dynamic response patterns of import volume to changes in both prices. "*When forming expectations about price changes, economic agents are likely to use different information sets for the two prices so that one can expect short-run domestic price effects to be more important in magnitude or at least to occur more immediately than import price effects*", (Urbain, 1996).

Some authors[1] impose homogeneity in the long run only by arguing that the short-run patterns may differ. But, insofar as we are interested by a long-run relationship, the pertinent econometric method is to estimate a cointegration relationship. So, this relation depends on the stochastic nonstationarity/stationarity properties of the data. Consider a log-linear specification of the model (1). The writing of the model will depend on $Ln(P_{Mit})$ and $Ln(P_{dit})$ statistical properties, where *Ln* is the neperian logarithm. If there are non stationary and cointergtaed, i.e. $Ln(P_{Mit}/P_{dit})$ is stationary, it will be necessary to distinguish two separate price terms. So, two econometric models are possible: either

$$Ln(M_{it} / P_{Mit}) = \alpha.Ln(Y_t) + \beta.Ln(P_{Mit} / P_{dit}) + \gamma + \varepsilon_t \tag{2}$$

with $\alpha>0$ and $\beta<0$, γ the intercept, ε the random disturbance term with its usual classical properties; or

$$Ln(M_{it} / P_{Mit}) = \alpha.Ln(Y_t) + \beta 1.Ln(P_{Mit}) + \beta 2.Ln(P_{dit}) + \gamma + \varepsilon_t \tag{3}$$

with $\alpha>0$, $\beta1<0$ and $\beta2>0$.

4. Cointegration analysis in the presence of structural breaks

To apply a cointegration technique, we must first determine the order of integration of each variable. We gather annual data during 1971–2007 and transform all variables to their logarithm forms (*Ln*). Thus, *LnGDP* is the log of Chinese or U.S. GDP, *LnM* is the log of sectoral Japanese real imports, *LnPd* is the Log of domestic/corporate prices[2], *LnPR* is the log of relative prices.

Because the presence of breaks in the variables can render the statistical results invalid, for not only the unit root tests but also the cointegration tests, we retain tests with the breaks developed by Saikkonen and Lütkepohl (2000, 2002).

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[1] See for example Wilson and Tackacs (1979).

[2] For Raw Material sector, we calculate a price index as an average between wood, non ferrous metal and iron prices.

4.1. Unit root tests

To examine the statistical properties of the series, we use unit root tests, specifically, the augmented Dickey-Fuller (ADF) test and the Saikkonen and Lütkepohl (SL) test, which take into account the influences of unknown structural changes in the data. In addition, Saikkonen and Lütkepohl (2002; see also Lanne and Saikkonen, 2002) posit that a shift may spread over several periods rather than being restricted to a single period (Lütkepohl, 2004). The tests we use enable us to examine the null hypothesis of a unit root based on the following general specification:

$$X_t = \mu_0 + \mu_1 . t + f_t(\theta)' \gamma + z_t , \tag{4}$$

where θ and γ are unknown parameters, t is the time trend, the error term z is generated by an *AR(p)* process, and $f_t(\theta)' \gamma$ is the shift function, which depends on θ and the regime shift date T_B. We thus consider three shift functions:

1. A simple shift dummy,

$$f_t^1 = d_{1,t} = \begin{cases} 0, & t < T_B \\ 1, & t \geq T_B \end{cases} . \tag{5}$$

2. The exponential distribution function, which allows for a nonlinear gradual shift to a new level, starting at time T_B,

$$f_t^2(\theta) = \begin{cases} 0, & t < T_B \\ 1 - \exp[-\theta(t - T_B + 1)], & t \geq T_B \end{cases} . \tag{6}$$

3. A rational function in the lag operator applied to a shift dummy,

$$f_t^3(\theta) = \begin{bmatrix} \dfrac{d_{1,t}}{1-\theta L} \\ \dfrac{d_{1,t-1}}{1-\theta L} \end{bmatrix} . \tag{7}$$

We first estimate the deterministic term with generalized least squares (GLS),[3] then apply an ADF test to the adjusted data, which include the series obtained by subtracting them from the original series[4]. Following the data observations, we decide to retain or not a linear trend for the series. Table 2 summarizes the results from the ADF and SL tests, which generally diverge and thereby confirm that the regime shifts are significant.

When we consider the three different SL tests, we find support for the non stationary hypothesis in most of cases, i.e. the random walk. In a few cases, the tests do not produce a clear conclusion. In the latter case, we consider these variables nonstationary.

Table 2: *Unit Root Tests 1971–2007*

	Trend	*ADF Tests*	*SL Tests (break date unknown a priori)*				*Conclusion*
Variables (Sectors)		*t-stat. (a)*	*Break date*	*Shift dummy t-stat(b)*	*Exp. distrib. t-stat(b)*	*Rational function t-stat(b)*	
GDP Japan							
	no	*-2.0780*	*1994*	*-3.6238***	*-3.6749***	*-2.3765*	*I(1) or I(0)*
Imports from China							
Foods	*no*	*-1.0365*	*1985*	*-1.7408*	*-2.9014***	*-3.8729***	*I(1) or I(0)*
Raw Material	*yes*	*-3.0100*	*1976*	*-1.9426*	*-2.1705*	*-3.3360***	*I(1)*
Min. Fuel	*yes*	*-3.2302**	*1977*	*0.3596*	*-0.3152*	*0.4822*	*I(1)*
Chemicals	*yes*	*-2.4027*	*1976*	*-2.6345*	*-2.1409*	*-0.6674*	*I(1)*
Textile	*no*	*-0.8560*	*1976*	*-2.0599*	*-2.7846**	*-2.1491*	*I(1)*
Mach. Eq.	*no*	*-2.8062*	*1982*	*-1.3159*	*-1.4073*	*-2.6158*	*I(1)*
Imports from United States							
Foods	*yes*	*1.0925*	*1987*	*-0.5971*	*-0.4105*	*-0.9245*	*I(1)*
Raw Material	*no*	*-0.7165*	*1998*	*-1.4503*	*-3.6514***	*-3.7589***	*I(1) or I(0)*
Min. Fuel	*no*	*0.0835*	*2004*	*0.9614*	*1.0156*	*-0.3650*	*I(1)*
Chemicals	*no*	*-2.7270**	*1976*	*-1.1934*	*-7.3290***	*-5.8720***	*I(1) or I(0)*
Textile	*no*	*-1.2147*	*1979*	*-1.2331*	*-1.3142*	*-2.2055*	*I(1)*
Mach. Eq.	*no*	*-0.8028*	*1988*	*-0.4230*	*-1.3678*	*-2.2295*	*I(1)*

**Significant at 10% level. **Significant at 5% level. (a)For the ADF test, the lags are determined by the Schwartz criterion. Critical values extracted from Davidson and MacKinnon (1993) for the 1%, 5%, and 10% levels are, respectively, -3.96, -3.41, and -3.13 for the model with trend and -3.43, -2.86, and -2.57 for the model without trend.*

(b) Critical values from Lanne et al. (2002) for the 1%, 5%, and 10% levels are, respectively, -3.55, -3.03, and -2.76 for the model with trend and -3.48, -2.88, and -2.58 for the model without trend.

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[3] T_B corresponds to the date at which the GLS objective function is minimized.

[4] The adjusted series are $\hat{X}_t = X_t - \hat{\mu}_0 + \hat{\mu}_1 .t + f_t(\hat{\theta})' \hat{\gamma}$.

Table 2: *Unit Root Testss 1971–2007 (continued)*

	Trend	*ADF Tests*	*SL Tests (break date unknown a priori)*				*Conclusion*
Variables (Sectors)		*t-stat. (a)*	*Break date*	*Shift dummy t-stat(b)*	*Exp. distrib. t-stat(b)*	*Rational function t-stat(b)*	
				Relative Prices			
Foods	*no*	*-1.8757*	*1978*	*-1.6451*	*-1.5894*	*-2.0957*	*I(1)*
Raw Material	*no*	*-1.2081*	*1979*	*-2.2461*	*-2.9680***	*-2.9823***	*I(1) or I(0)*
Min. Fuel	*no*	*-1.1952*	*1986*	*-1.9778*	*-2.0357*	*-1.7039*	*I(1)*
Chemicals	*no*	*-2.5260*	*1986*	*-1.9003*	*-1.7179*	*-1.7202*	*I(1)*
Textile	*no*	*-1.5960*	*1986*	*-2.6593**	*-2.8445**	*-4.7387***	*I(1) or I(0)*
Mach. Eq.	*yes*	*-2.5511*	*1986*	*-2.5312*	*-2.4329*	*-2.0611*	*I(1)*
				Import Prices			
Foods	*no*	*-1.4674*	*1978*	*-1.3406*	*-1.2716*	*-1.8564*	*I(1)*
Raw Material	*no*	*-1.5959*	*1979*	*-1.6429*	*-2.6895**	*-2.6998**	*I(1) or I(0)*
Min. Fuel	*no*	*-3.0591***	*1986*	*-0.8191*	*-0.7581*	*-0.3749*	*I(1)*
Chemicals	*no*	*-1.2411*	*1986*	*-1.3942*	*-1.2805*	*-0.1793*	*I(1)*
Textile	*no*	*-1.2013*	*1986*	*-2.3745*	*-2.5622*	*-2.9739**	*I(1)*
Mach. Eq.	*yes*	*-2.8536*	*1986*	*-1.4122*	*-1.4126*	*-1.4252*	*I(1)*
				Domestic/Corporate Prices			
Foods	*yes*	*-8.9205***	*1980*	*0.3422*	*-0.2330*	*1.4779*	*I(1)*
Raw Material	*no*	*-1.9304*	*1976*	*-1.6901*	*-2.0698*	*-2.2458*	*I(1)*
Min. Fuel	*no*	*-3.0395***	*1980*	*-0.4555*	*-0.4926*	*-0.2452*	*I(1)*
Chemicals	*no*	*-5.5989***	*1980*	*-2.0967*	*-2.1036*	*-0.5494*	*I(1)*
Textile	*yes*	*-3.0912***	*1976*	*-0.8955*	*-0.8341*	*-1.4133*	*I(1)*
Mach. Eq.	*no*	*-7.9652***	*1980*	*-1.5722*	*-1.0534*	*-2.6918**	*I(1)*

**Significant at 10% level. **Significant at 5% level. (a)For the ADF test, the lags are determined by the Schwartz criterion. Critical values extracted from Davidson and MacKinnon (1993) for the 1%, 5%, and 10% levels are, respectively, -3.96, -3.41, and -3.13 for the model with trend and -3.43, -2.86, and -2.57 for the model without trend. (b) Critical values from Lanne et al. (2002) for the 1%, 5%, and 10% levels are, respectively, -3.55, -3.03, and -2.76 for the model with trend and -3.48, -2.88, and -2.58 for the model without trend.*
For wood prices, we have respectively for SL tests the t-stat: -2.3366; -2.4146; -3.5471 for relative price; -2.0702; -2.1894; -2.6998 for import price; -0.4619; -1.1098; -1.0998 for corporate price. The break date is 1979. For ADF tests (without trend), we obtain t-stat; -2.4629 for relative price; -2.6948 for imports price and -2.8573 for corporate price.

4.2. Cointegration tests

In the next step of the analysis, we investigate the number of cointegration relations between series. Following Saikkonen and Lütkepohl (2000) and Demetrescu et al. (2008), we consider tests for the cointegrating rank of a variance autoregressive process when the data generating process y contains a deterministic component (μ) and a stochastic component (x), such that $y_t = \mu_t + x_t$. We also assume μ is generated by a process with a constant, linear trend and shift dummy variables of the form $D_{TB} = 0 \ for \ t \leq T_B \ and \ D_{TB} = 1 \ for \quad t > T_B$, such that $\mu_t = \mu_0 + \mu_1.t + \delta.D$, where $t = 1, 2, \ldots, T$. If μ does not have a linear trend (i.e., $\mu_1 = 0$), the term may be dropped. We estimate the parameters of the deterministic part using feasible GLS. With these estimates, we can adjust y to obtain $\hat{x}_t = y_t - \hat{\mu}_0 - \hat{\mu}_1..t - \hat{\delta}.D$, then apply the Johansen likelihood ratio (LR) test for the cointegrating rank to $\hat{x}_t$. In other words, the test is based on a reduced rank regression of the system

$$\Delta\hat{x}_t = \Pi\hat{x}_{t-1} + \sum_{i=1}^{p-1}\Gamma_i\Delta\hat{x}_{t-i} + u_t . \tag{8}$$

The critical values depend on the kind of deterministic term included. We consider a constant and shift dummies determined by the unit root tests with the break[5]. In Tables 3 and 4, we list the results of various cointegration tests, based on models on the order of $p=2$.

For all import models, i.e. all sectors and the two versions of the model, we find at least one cointegration relation.

In the case of Japanese imports from China (table 3), when we retain the model with distinct prices (version 2), we find at least one cointegration relation for two sectors (foods and raw material), at least two cointegration relations for two sectors (chemicals, machinery and equipments) and at least three relations for two other sectors (mineral fuels and textile).

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[5] For space considerations, we do not present the tests with a linear trend orthogonal to the cointegration relations, though they confirm the precedent conclusions.

Table 3: *Results from Cointegration Tests, Japan–China*

SL Tests (without trend; $\mu = \mu_0 + \delta.D$ *) (a)*

LR Statistics (lag=2)

$H_0(r_0): r = r_0$		*r_0=0*	*r_0=1*	*r_0=2*	*r_0=3*	
$H_1(r_0): r > r_0$		*r>0*	*r>1*	*r>2*	*r>3*	
Sectors						*Deterministic terms*
Foods	*1*	*41.81***	*7.53*	*2.07*		*Constant, D78, D85, D94*
		(0.0001)	*(0.280)*	*(0.177)*		
	2	*39.82***	*14.12*	*9.24*	*2.33*	*Constant, D78, D80, D85, D94*
		(0.053)	*(0.534)*	*(0.157)*	*(0.149)*	
Raw Material	*1*	*43.07***	*4.92*	*1.07*		*Constant, D76, D79, D94*
		(0.000)	*(0.582)*	*(0.347)*		
	2	*53.28***	*15.84*	*8.88*	*0.98*	*Constant, D76, D79, D94*
		(0.001)	*(0.398)*	*(0.178)*	*(0.370)*	
Mineral Fuels	*1*	*47.63***	*19.16***	*4.76***		*Constant, D77, D86, D94*
		(0.000)	*(0.002)*	*(0.034)*		
	2	*51.27***	*22.20**	*11.66**	*5.13***	*Constant, D77, D80, D80, D94*
		(0.002)	*(0.088)*	*(0.063)*	*(0.028)*	
Chemicals	*1*	*22.37**	*6.85*	*2.11*		*Constant, D76, D86, D94*
		(0.084)	*(0.345)*	*(0.172)*		
	2	*45.89***	*22.33**	*5.77*	*0.08*	*Constant, D76, D80, D86, D94*
		(0.011)	*(0.085)*	*(0.469)*	*(0.835)*	
Textile	*1*	*24.50***	*6.40*	*0.34*		*Constant, D76, D86,D94*
		(0.045)	*(0.394)*	*(0.621)*		
	2	*74.41***	*30.79***	*12.54***	*2.44*	*Constant, D76, D86,D94*
		(0.000)	*(0.005)*	*(0.044)*	*(0.139)*	
Mach. Equip.	*1*	*24.22***	*10.27**	*1.71*		*Constant, D82, D86, D94*
		(0.049)	*(0.108)*	*(0.223)*		
	2	*60.73***	*25.79***	*7.13*	*0.05*	*Constant, D80, D86, D94*
		(0.0001)	*(0.030)*	*(0.317)*	*(0.864)*	

Notes: H_0 *is the null hypothesis; r is the number of cointegration vectors. We compute the SL tests with JMulTi software. P-values in parentheses from Trenkler (2003). At the .05 level (0.10 level), the critical values are respectively 24.16(21.76), 12.26(10.47), 4.13(2.98) for the model with three variables, and 40.07(37.04), 24.16(21.76), 12.26(10.47), 4.13(2.98) for the model with four variables. *Rejection of the hypothesis at the .05 level. **Rejection of the hypothesis at the .10 level.*

(a) Note that if a trend is orthogonal to the cointegration relations, it is captured by the intercept term.

(1) for model with relative price; (2) for model with import price and corporate price.

Table 4*: Results from Cointegration Tests, Japan–United States*

SL Tests (without trend; $\mu = \mu_0 + \delta.D$ *) (a)*

LR Statistics (lag=2)

$H_0(r_0): r = r_0$ $H_1(r_0): r > r_0$		$r_0=0$ *r>0*	$r_0=1$ *r>1*	$r_0=2$ *r>2*	$r_0=3$ *r>3*	
C.V. 5%		*40.07*	*24.16*	*12.26*	*4.13*	*Deterministic terms*
C.V. 10%		*37.04*	*21.76*	*10.47*	*2.98*	
Sectors						
Foods	*1*	*37.47*** *(0.0004)*	*13.87*** *(0.026)*	*1.51* *(0.254)*		*Constant, D78, D87, D94*
	2	*47.08*** *(0.008)*	*32.77*** *(0.003)*	*11.31** *(0.073)*	*0.05* *(0.864)*	*Constant, D78, D87, D94*
Raw Material	*1*	*44.46*** *(0.000)*	*6.61* *(0.371)*	*2.09* *(0.174)*		*Constant, D76, D79, D94, D98*
	2	*54.63*** *(0.001)*	*36.19*** *(0.001)*	*3.06* *(0.835)*	*1.59* *(0.242)*	*Constant, D76, D79, D94, D98*
Mineral Fuels	*1*	*27.54*** *(0.017)*	*7.99* *(0.241)*	*1.13* *(0.332)*		*Constant, D86, D94,D04*
	2	*38.55** *(0.071)*	*19.33* *(0.187)*	*4.68* *(0.616)*	*4.47*** *(0.041)*	*Constant, D80, D86, D94, D04*
Chemicals	*1*	*28.21*** *(0.013)*	*11.52** *(0.067)*	*1.41* *(0.273)*		*Constant, D76, D86, D94*
	2	*69.57*** *(0.000)*	*43.94*** *(0.000)*	*6.38* *(0.397)*	*0.02* *(0.926)*	*Constant, D76, D80, D86, D94*
Textile	*1*	*37.65*** *(0.0004)*	*4.89* *(0.586)*	*0.47* *(0.554)*		*Constant, D79, D86, D94*
	2	*68.52*** *(0.000)*	*29.89*** *(0.008)*	*7.80* *(0.256)*	*0.02* *(0.921)*	*Constant, D76, D79, D86, D94*
Mach. Equip.	*1*	*22.35** *(0.084)*	*9.02* *(0.169)*	*1.36* *(0.282)*		*Constant, D86, D94*
	2	*57.04*** *(0.0003)*	*40.15*** *(0.0001)*	*11.61** *(0.065)*	*0.06* *(0.857)*	*Constant, D80, D86, D94*

Notes: H_0 *is the null hypothesis; r is the number of cointegration vectors. We compute the SL tests with JMulTi software. P-values in parentheses from Trenkler (2003). At the .05 level (0.10 level), the critical values are respectively 24.16(21.76), 12.26(10.47), 4.13(2.98) for the model with three variables, and 40.07(37.04), 24.16(21.76), 12.26(10.47), 4.13(2.98) for the model with four variables. *Rejection of the hypothesis at the .05 level. **Rejection of the hypothesis at the .10 level.*

(a) Note that if a trend is orthogonal to the cointegration relations, it is captured by the intercept term.

(1) for model with relative price; (2) for model with import price and corporate price.

For the Japanese imports from USA and the second model with distinct prices (table 4), we find at least one cointegration relation for two sectors (mineral fuels and chemicals), at least two cointegration relations for two sectors (raw materials and textile) and at least three relations for two other sectors (foods, machinery and equipments).

5. Import equations

Tables 5 and 6 present results for the estimations of cointegration relationships, for two partners and two versions of the model. A synthesis of results is exposed in Tables 7 and 8. For the version 1 of the model, the coefficients of domestic demand (GDP) and relative prices are significant in all cases and with expected signs. One should note that for four sectors of imports from China (table 5) and for three sectors of imports from USA (table 6), the demand elasticity is higher than the price elasticity. In other cases, the values of elasticities are close in absolute value. For the version 2 of the model, we distinguish domestic and import prices. We verify that the homogeneity hypothesis can be rejected. Indeed, in most of the cases, i.e. four cases on six for imports from China, and three cases on six for Imports from USA, the elasticities with respect to domestic prices are nearly double (in absolute value) than the ones with respect to imports prices. These results lead to reject the assumption of price homogeneity. The differences of volatilities of the prices can be at the origin of these differences in the price elasticities. Indeed, the volatility of the prices may indicate different degrees of uncertainty associated with change in the two prices. So, "*the information set that consumers and producers use to forecast the price of goods abroad will usually be more limited than the information set used for the prices of domestic goods*" (Petousssis, 1985, p.92).

Table 5: *Normalized Cointegrating Equations Japan–China 1971–2007*

Variables Sectors		Lag	LnGDPjapan	LnPR	LnPdjap	LnP_M	Trend	Deterministic terms
Foods	1	4	0.632*	-0.768**				Constant, D78, D85, D94
			(0.105)	(0.000)				
	2	4	1.030**		1.445**	-0.700**		Constant, D78, D80, D85, D94
			(0.000)		(0.000)	(0.000)		
Raw Material	1	4	1.217**	-0.154*			0.012**	D76, D79, D94
			(0.000)	(0.096)			(0.000)	
	2	2	0.625*		0.821	-0.405	0.028**	D76, D79, D94
			(0.094)		(0.200)	(0.191)	(0.000)	
Mineral Fuel	1	2	2.792**	-0.543			-0.069**	Constant, D77, D86, D94
			(0.045)	(0.422)			(0.018)	
	2	4	3.430**		0.775**	-0.176	-0.109**	Constant, D77, D80, D86, D94
			(0.000)		(0.000)	(0.166)	(0.000)	
Chemicals	1	4	1.363**	-0.747**			0.094**	D76, D86, D94
			(0.000)	(0.000)			(0.000)	
	2	4	0.575**		2.740**	0.054	0.084**	Constant, D76, D80, D86
			(0.001)		(0.000)	(0.120)	(0.000)	
Textile	1	4	2.154**	-1.219**				TDsh76, D86, D94
			(0.002)	(0.029)				
	2	2	3.519*		-1.879**	-0.529**		Constant, TDsh76, TDsh94
			(0.000)		(0.000)	(0.060)		
Mach. Equip.	1	4	1.782**	-2.112**			0.193**	D82, D86, D94
			(0.001)	(0.000)			(0.000)	
	2	2	2.349**		0.109	-2.234**		D82, D86, D94
			(0.001)		(0.906)	(0.000)		

*Notes: p-values in parentheses. ** Significant at the 5% level. * Significant at the 10% level.*
D for Shift Dummy; TDsh for Trend Shift Dummy.

Table 6: *Normalized Cointegrating Equations Japan–USA 1971–2007*

Variables *Sectors*		*Lag*	*LnGDPjapan*	*LnPR*	*LnPdjap*	LnP_M	*Trend*	*Deterministic terms*
Foods	*1*	*2*	*0.551**	*-0.660***			*-0.020***	*Constant, D78, D87, D94*
			(0.104)	*(0.000)*			*(0.002)*	
	2	*1*	*0.616***		*1.002***	*-0.567***	*-0.026***	*D78, D80, D87, D94*
			(0.000)		*(0.000)*	*(0.000)*	*(0.000)*	
Raw Material	*1*	*1*	*1.429***	*-0.211**			*-0.050***	*D76, D79, D94, D98*
			(0.000)	*(0.056)*			*(0.000)*	
	2	*3*	*2.292***		*1.470***	*-0.554**	*-0.084***	*Constant, D76, D79, D94, D98*
			(0.000)		*(0.032)*	*(0.084)*	*(0.000)*	
Mineral Fuel	*1*	*5*	*1.034***	*-0.968***			*-0.095***	*Constant, D86, D94, D04*
			(0.000)	*(0.000)*			*(0.000)*	
	2	*4*	*1.494***		*0.040*	*-0.701***	*-0.120***	*Constant, D80, D86, D94, D04*
			(0.000)		*(0.917)*	*(0.008)*	*(0.000)*	
Chemicals	*1*	*4*	*1.863***	*-1.048***				*Constant, D76, D86, D94*
			(0.000)	*(0.000)*				
	2	*4*	*1.407***		*1.595***	*-0.572***		*Constant, D76, D80, D86, D94*
			(0.000)		*(0.000)*	*(0.000)*		
Textile	*1*	*3*	*2.331***	*-1.026***			*-0.057***	*D79, D86, D94*
			(0.000)	*(0.000)*			*(0.000)*	
	2	*1*	*5.543***		*1.035*	*-1.140***	*-0.123***	*Constant, D76, D79, D86, D94*
			(0.000)		*(0.296)*	*(0.027)*	*(0.000)*	
Mach. Equip.	*1*	*5*	*1.041***	*-0.889***				*Constant, TDsh86, D88, D94*
			(0.000)	*(0.000)*				
	2	*4*	*1.031***		*0.226*	*0.258*		*Constant, D80, TDsh86, D88, D94*
			(0.011)		*(0.846)*	*(0.209)*		

*Notes: p-values in parentheses. ** Significant at the 5% level. * Significant at the 10% level.*
D for Shift Dummy; TDsh for Trend Shift Dummy.

Table 7*: Synthesis of Long-Run Effects on Japanese Imports from China*

Sectors	*Foods*	*Raw Materials*	*Mineral Fuels*	*Chemicals*	*Textile*	*Machinery Equipment*
Model with relative price						
LnGDP	>0	>0	>0	>0	>0	>0
LnPR	<0	<0	<0 (NS)	<0	<0	<0
Model with domestic and import prices						
LnGDP	>0	>0	>0	>0	>0	>0
LnPd	>0	>0 (NS)	>0	>0	<0	>0 (NS)
Ln P_M	<0	<0 (NS)	<0 (NS)	>0 (NS)	<0	<0

Notes: *NS indicates not significant at the* 10% level.

Table 8: *Synthesis of Long-Run Effects on Japanese Imports from USA*

Sectors	*Foods*	*Raw Materials*	*Mineral Fuels*	*Chemicals*	*Textile*	*Machinery Equipment*
Model with relative price						
LnGDP	>0	>0	>0	>0	>0	>0
LnPR	<0	<0	<0	<0	<0	<0
Model with domestic and import prices						
LnGDP	>0	>0	>0	>0	>0	>0
LnPd	>0	>0	>0 (NS)	>0	>0 (NS)	>0 (NS)
Ln P_M	<0	<0	<0	<0	<0	>0 (NS)

Notes: *NS indicates not significant at the* 10% level.

We calculate these volatilities as standard deviations of the growth rate of the sectoral prices over the period. Results presented in table 9 confirm higher volatilities for import prices than domestic prices. This reveals two important points. Firstly, a higher volatility of

Table 9: *Volatility of prices 1971-2007*

	Volatilities			Variance ratio (a)
Sectors	SDP_M	SDPd	SDP_M/SDPd	F-statistics
Foods	0,0571	0,0201	2,8412	8,0724**
Raw Material	0,0614	0,0359	1,7094	2,9220**
Mineral Fuel	0,1179	0,0657	1,7960	3,2255**
Chemicals	0,0433	0,0315	1,3730	1,8851**
Textile	0,0475	0,0257	1,8461	3,4079**
Mach. Equip.	0,0357	0,0204	1,7512	3,0668**

SDP_M; Volatility of import price. SDPd; Volatility of Domestic/Corporate price.
SDP_M/SDPd ; ratio of volatilities
*(a) This ratio has an F-distribution with 36 and 36 degrees of freedom. ** indicates that the null hypothesis of equality of variances is rejected at the* 5% level. $F_{40,40,0.05}=1.69$.

imports price may result of a higher volatility of the exchange rate of the yen. Indeed, for each *i* sector we have $P_{Mi} = P^*_{Mi} / N_{yen}$ [6]where P^*_{Mi} represents the world price of the *i* good and N_{yen} the nominal exchange rate of the yen (a rise of *N* is synonym of an appreciation of the yen). Secondly, the differences of volatilities between the sectors may also reflect the differences in the volatilities of the world prices in different sectors.

Therefore, a change in P_M has a lower probability of being considered as permanent compared to an equivalent change in *Pd*. According to these observations, domestic agents will react more weakly to the variations of the prices of the imported goods.

6. Concluding remarks

The objective was to analyze the determinants of Japanese imports from the two main partners, China and the USA. A sectoral approach have permitted to show that if domestic demand affects positively the imports, the impact of prices changes can be different whether we retain the relative prices (homogeneity hypothesis) or we consider both domestic and import prices. As expected, the relative prices changes have a negative effect on imports. However, when we decompose the relative prices between imports prices and domestic (corporate) prices, except in one case (textile imports from the USA), we can reject the homogeneity hypothesis.

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[6] So, we have $Var(\Delta LogP_M) = Var(\Delta LogP^*_M) + Var(\Delta LogN_{yen}) - 2Cov(\Delta LogP^*_M, \Delta LogN_{yen})$

In most of cases, the coefficients of domestic prices are double than the ones with respect of import prices. A possible explanation is the greater volatility of import prices than domestic prices which leads importers to wait when import prices change, insofar as they don’t know if these changes are temporary or permanent. We show that this hypothesis is verified for three sectors, at the same time for imports from China and imports from USA. It remains one case, textile imports from China, for which we obtain a negative sign of domestic price coefficient contrary to expectations.

A possible extension of this work would be to introduce a FDI (Foreign Direct Investment) variable in the model and to estimate the import equations on subperiods after a stability analysis.

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Appendix

Data Sources

Information about imports of Japan from China and the United States come from several editions of the *Japan Statistical Yearbook*. To obtain the volume of sectoral Japanese imports (real imports), we divide the value series by the import price indexes of each sector. Data on domestic and import prices are extracted from Bank of Japan; http://www.boj.or.jp/en/theme/stat/index.htm. Japanese GDP data are extracted from IFS CD-Rom.